Space Weather Technical Forecast

Issued on Saturday, 25 June 2022 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic storm late day 1 (25th) or early day 2 (26th). Active electron fluence likely by day 4 (28th)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Low over the past 24 hours, with only one small C-class flare. There are four sunspot regions on the disc, however they are all magnetically simple and stable, with the most notable region AR3038 Eho/Beta in the northwest. A filament in the northwest disc was seen to lift off on the 24 June, with a weak CME observed on STEREO A cor2 imagery, however no corresponding CME was visible on SOHO coronagraph data. This has been assessed as missing, with a slight chance of an Earth-directed component, although confidence is very Low.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured at L1 was slightly elevated at 410-450km/s. Density was at or just below average levels. The total Interplanetary Magnetic Field (IMF) started weak at 6-8nT, but increased at 25/0830 UTC to be moderate at 10nT, before climbing further to 14nT by the end of the period. The Bz component became mainly negative for much of the period, with peak southward value of -7nT, before becoming variable after 25/0800 UTC, varying between -10nT and +10nT. This IMF trace suggests a potential weak transient passing, before a transition into the CIR region ahead of CH95/-. The resulting geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) as measured by GOES16 remained at Background levels through the period. High energy electron flux (greater than 2MeV) peaked at High levels, with 981 pfu observed at 24/1525 UTC, but dropped out to mainly background since 25/0000 UTC. The corresponding 24-hour electron fluence remained below the Active threshold (1e8 integrated pfu) with an observed fluence of 3.58e7 integrated pfu at 25/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low to very Low, with only a slight chance of increasing to Moderate with any M-flares that occur.

Solar Wind / Geomagnetic Activity: The CME from the 24th is expected to miss, passing just ahead, but may give a glancing blow early on day 4 (28th). Solar winds are expected to become elevated day 1 and then persist at this level due to fast wind enhancement from CH95/-, with further influence from CH93/- and CH94/-, before gradually easing day 4 (28th). Geomagnetic activity is likely to increase from initially Quiet to Unsettled to Active, with a chance of G1/Minor Storms on day 1 (25th) and into day 2 (26th). Easing to Quiet with Unsettled spells and a slight chance of Active intervals thereafter.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to remain at Background, with only a very slight chance of rising above this level due to the location of AR3038 and any flaring that may occur from this region. The high energy electron flux (greater than 2 MeV) should show a gradual rising trend day 2 (26th) onward, in response to the arrival of the coronal hole fast wind. Flux levels likely reaching High day 3 (27th)

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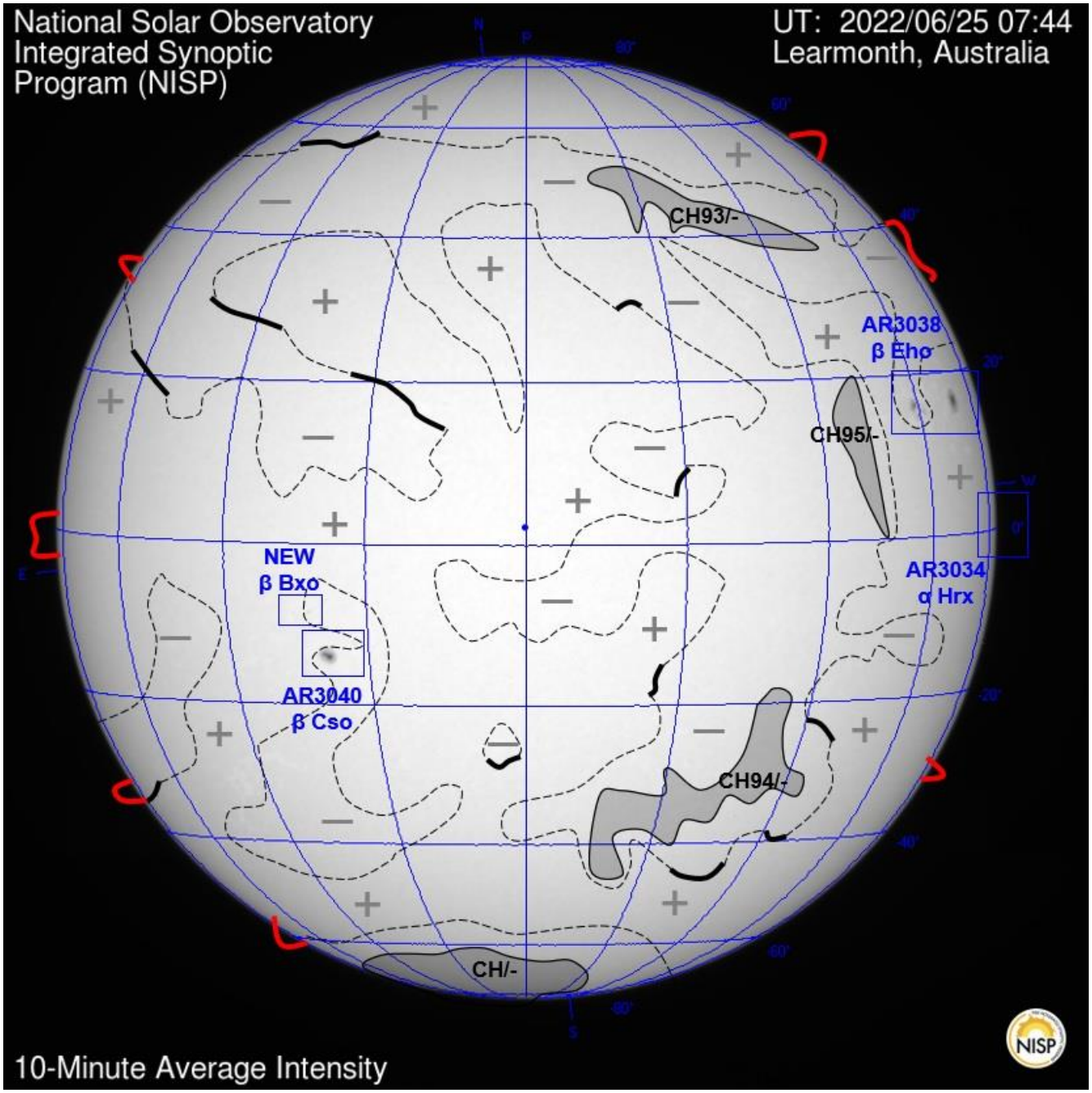
onward. Corresponding electron fluence is expected to develop an eventual rising trend, with Active (1e8 integrated pfu) fluence becoming Likely late day 3 or day 4 (27th and 28th).

Figure 1. Solar Analysis Valid 25/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no significant CMEs on the Earth-Sun line, however a filament eruption on the 28th produced a weak CME that was visible on STEREO A cor2 imagery. This has been assessed as passing just ahead of Earth, but may give a glancing interaction early on day 4 (28th), although this assessment is low confidence due to the lack of significant CME signal on SOHO coronagraphs.

Current solar wind conditions observed at L1 suggest Earth is moving into a CIR region that likely signals the arrival of CH95/-. fast winds on day 1 (25th) Ongoing solar wind enhancement is likely day 2 and day 3 with influence from CH93/- and CH94/- before easing day 4 (28th).

Geomagnetic activity is likely to increase from initially Quiet to Unsettled to Active, with a chance of G1/Minor Storms on day 1 (25th) and into day 2 (26th). This easing to Quiet with Unsettled spells and a slight chance of Active intervals thereafter. Perhaps increasing again to Unsettled to Active with any glancing CME interaction early day 4, however this is very low risk.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Wind Persistence Model

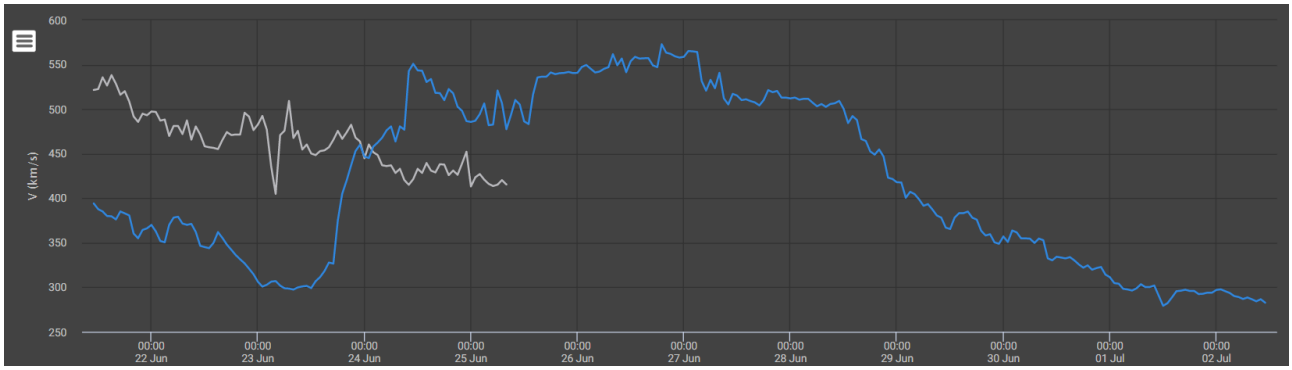

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Figure 3: Enlil and Ensemble

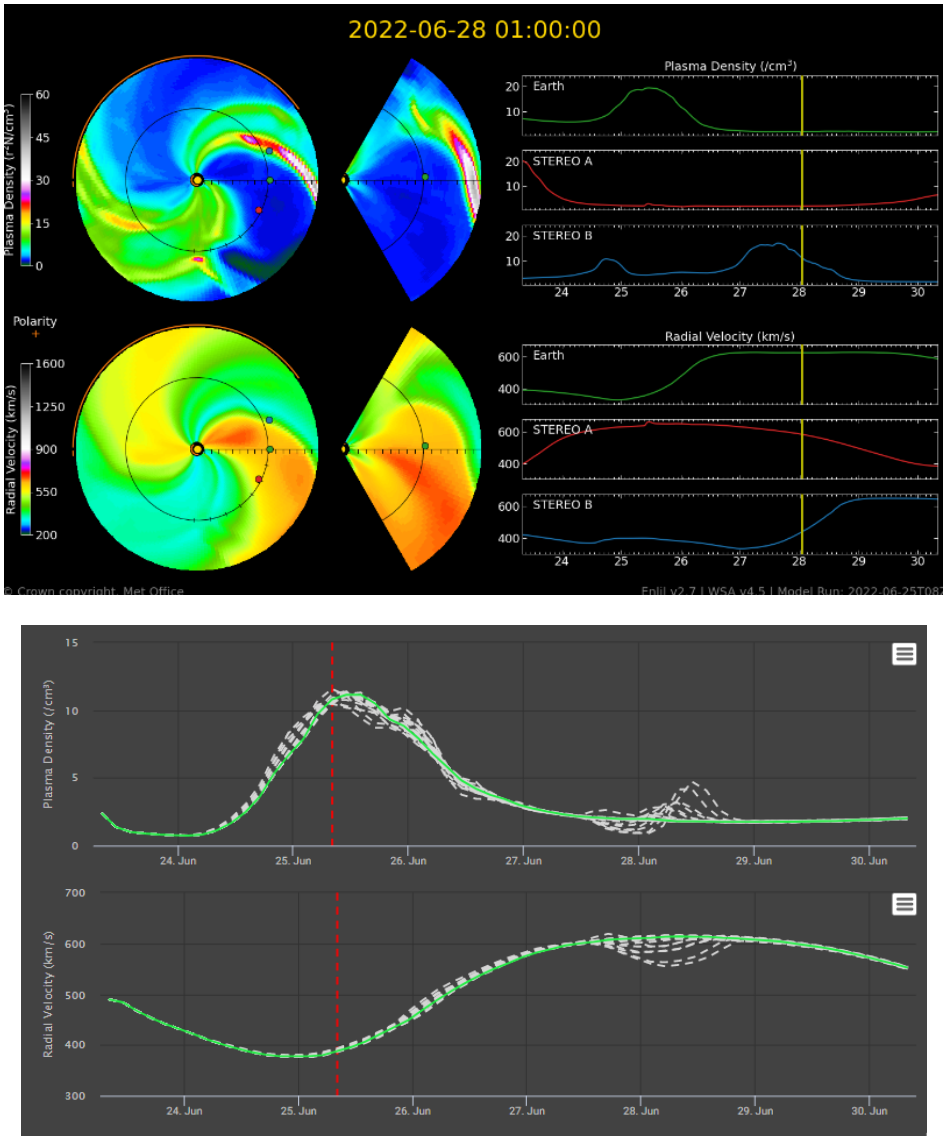
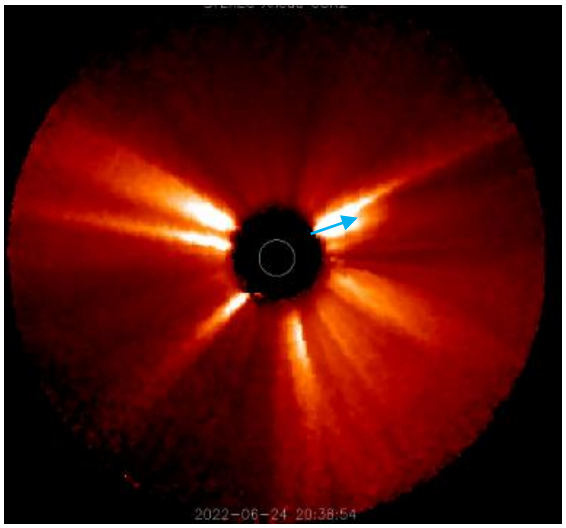


Figure 4: STEREO A Cor2 showing CME to NW



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Radio Blackouts - X-Ray Flares:

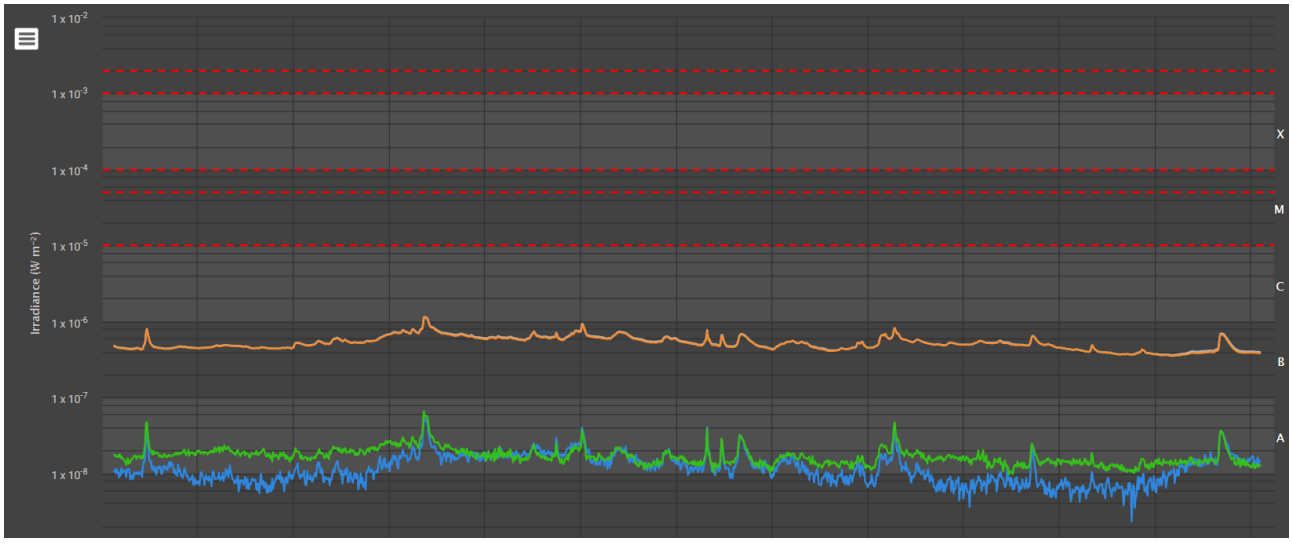
There are currently four active regions on the visible disc, with three of these numbered and a further very small unnumbered region recently developing. The most prominent and largest of these regions is AR3038 Eho/Beta in the northwest, however this region has remained relatively stable, with a simple magnetic configuration. AR3034 Hrx/alpha is now on the west limb, and will very soon transit off the Earth-facing disc, while AR3038 Cso/Beta in the southeast disc remains small and simple. The new region Bxo/Beta has developed to the northeast of AR3038.

Activity has remained Low with only one small C-flare in the last 24 hours, and is expected to persist either at Low or Very Low throughout. There is a slight chance of increasing to Moderate with isolated M-flares.

(Please note, SDO imagery is currently unavailable leading to a lack of high-resolution imagery for analysis. Consequently the current solar assessment is based primarily on GONG imagery supported by imagery from GOES SUVI).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 5: GOES-16 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and will most likely remain at this level through the period. There is a very slight chance of proton levels rising above background should any notable flare occur from AR3038 due to its location, now approaching the northwest limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, has dropped out in the last 12 hours, likely due to the arrival of the CIR of anticipated CH95/-. While any coronal hole soured solar wind enhancement is delayed compared to the previous rotation, according to the standard 27-day persistence, a similar electron flux response is likely. Flux levels are therefore expected to build through day 1 and day 2 (25th and 26th), and likely becoming generally High from day 3 (27th) onward. Any CME glance that occurs early on day 4 (28th) may lead to a drop out in values, however this is very low confidence.

The associated 24 hour fluence is expected to be below the Active level at first, but likely rising above the Active (1e8) threshold day either late day 3 (27th) or more likely day 4 (28th), similar to the previous rotated, but around 24 hours later than a standard 27-day persistence would suggest. This is currently not indicated by REFM, but this model will likely show a more notable rise once solar winds become elevated from the anticipated fast wind arrival on day 1 (25th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	20	40	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 6: GOES-16 >2MeV Electron Flux and Fluence

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